50. *Hierochloe submutica.*

Root creeping; stem together with its knots even; leaves flat, short, broad, linear, with their sheath somewhat scabrous; branches of the panicle spreading, the lower ones hardly drooping; pedicels somewhat hairy; bracteas with a nerve on both sides towards the base, lower one shorter than the flowers, the upper one a little broader and of the length of the calyx, their keel at last smooth; flowers indistinctly five to seven-nerved, all awnless or rarely the upper male one with a very short arista below the apex; margin of the female flower smooth, their back at the summit bearded; margin of the male flowers ciliated.

On the summits of the Cobboras mountains, at an elevation of 6,000 ft.

This elegant and nutritious grass luxuriated on the limits of eternal snow, like other Hierochloas of the arctic and alpine regions.

Its nearest affinity is with Hier. fragrans from North America.

V.

ON THE DETERIORATION OF GRAIN AND FLOUR.

BY JOHN MAUND, M.D.

READ 27TH NOVEMBER, 1854.

It has occurred to me, Mr. President and Gentlemen, that an enumeration of the chemical changes, and the best means of preventing such, that often take place in grain and their products, flour, meal, &c., during their transmission from

other countries to this colony, would not form an inappropriate subject for a paper, even at this early period of the existence of our Society; for though our main wish may be to develop and unraval the resources of Australia, still we must provide for the interval that occurs before this can be, or at least is accomplished.

And having, Sir, premised your concurrence in the above opinion, I shall offer no further apology for bringing forward the present subject for the consideration of the Society.

Though the subject admits, from its general connexion with the process known as fermentation, of entering into perhaps the most interesting and abstruse departments of practical and theoretical chemistry, I shall on the present occasion notice, but very cursorily, the changes called fermentation, on which mostly depends the alterations which take place in grain, flour, &c., when they become what is termed sour, unsound, or musty, on which changes, I have well ascertained, depends much of the unwholesomeness of food sold as bread, &c., to the Melbourne population.

As flour undergoes much the same change, and indeed more easily so, than unground grain does, I shall adopt this as a type of the whole.

During the last two years I have examined upwards of a hundred samples of what is termed by the merchants and bakers unsound flour; and certainly, the term is most appropriate when it is considered as the main staff of life.

It has appeared to me that different samples present two distinct states, though the one is probably only an advanced stage of the other.

First. That in which free acid is present, and is commercially known as sour flour.

Second. That in which no acid in a *free state* exists, but from which the volatile alkali, ammonia, can generally be eliminated and is known as musty flour.

The first change, where free acid exists, is much the most

common, and as a knowledge of its cause of production and the means of preventing its taking place are to the public most important, and, in addition, may be clearly explained, I shall relate these before referring to the chemical and atomic alterations which actually take place in the flour.

The cause then of good grain and flour becoming sour, during its transmission from other countries to this, is due to nothing more than fermentation: which is produced by the presence of moisture alone, but this is much facilitated by a high temperature and the presence of atmospheric air.

All grain or flour naturally contains water, the quantity of which varies according to their age &c. The amount of water contained in good wheat flour, varies from about six to sixteen per cent., though I have often found it to exist in a much larger proportion. The increase of which may be due to accidental or intentional causes.

Thus, the miller occasionally wets his wheat to assist the more perfect separation of the flour from the bran. Absorption of moisture may also occur from being in a damp atmosphere before it is packed, or by directly coming in contact with water before its voyage, or after its arrival here.

The main cause then of this change being appreciated, its remedy is very simple, and has long been more or less followed; this consists in using artificial heat, by the means of steam, hot air, &c., so as to expel the greater portion of the moisture. Great heat is not required to effect this, it should be moderate and prolonged, so as not to injure any of the qualities of the grain or flour. This precaution is frequently neglected, for I have often met with oats here considerably damaged by excess of heat being applied in the process often adopted before shipping, termed kiln drying. Though great heat is not required to prevent fermentation, that of the temperature of boiling water is often required to arrest it when commenced, and indeed such an opponent is this temperature to fermentation, that it will at once arrest it, even when going on in its most active form.

The theories regarding the fermentive process by which the acid state takes place are too numerous and complex to enter minutely into. Evidently it requires for its production a substance containing nitrogen, which by its contact, under favourable circumstances, with a substance containing oxygen, as do air and water, the equilibrium of the attractive forces which hold the organic atoms together is disturbed; a re-arrangement of the elements of the compound being produced, and the consequent formation of new products, for after fermentation has taken place a totally different substance is produced, while in some instances the chemical composition remains precisely the same. Take for instance, the sugar contained in milk, which is composed of carbon 12 atoms, hydrogen 12, and oxygen 12; by fermentation it is changed into lactic acid; (carbon 6, hydrogen 6, oxygen 6), two atoms of which correspond exactly in composition to one of the sugar. This seems to demonstrate that the change of properties depends solely on a change in the position of the atoms of the sugar of milk, they being merely re-arranged in a new order in the lactic acid.

In other cases gases, such as carbonic acid and hydrogen are given off, and it is easy to comprehend and calculate the change which takes place.

In plants starch, gum, sugar, &c., are often, Liebeg says, formed from organic acids, and doubtless a somewhat similar though opposite change occurs where these higher compounds are reduced to more simple ones, but in the present instance, if we look to the composition of cane sugar, (such as exists in wheat), which is composed of carbon 12, hydrogen 11, oxygen 11, we see it merely requires one atom of water, that is, one atom each of oxygen and hydrogen to make a compound of the same chemical composition as two atoms of lactic acid, which is the one mostly present in sour grain.

If instead we take starch or gum, (carbon 12, hydrogen 10, oxygen 10,) which enters largely into the

composition of wheat, but is less easily acted on than sugar, we have only to add two atoms of water to their composition, when we shall have the proper proportions to make lactic acid.

If the acid present be acetic acid, the change in composition is as easily made, for it merely requires two atoms of water in addition to one atom of starch, to produce three of vinegar or acetic acid.

The second state I referred to, where free acid is not present, but frequently exists in combination with ammonia, is generally found in the flour which is termed musty, and this, is often, in addition mouldy. This state, I believe, is merely a more advanced stage of the former or acid one, by two subsequent changes occurring, viz.:—first, the acid state is produced by fermentation, which is induced by moisture, as previously described; this acid when formed re-acts on another portion, the glutinous part of the grain, causing it to decompose; its nitrogen being set free unites with the hydrogen, forming ammonia, this being an alkali combines at once with the free acid forming a neutral compound from which the ammonia is easily eliminated by boiling with caustic or quick lime.

Thus, I regard this musty condition of flour as a state further advanced in decomposition, being an early stage of putrefaction, which if it continued to proceed would end in the carbon being converted into carbonic acid and the hydrogen into water.

If amongst our members present, there are any who have devoted attention to this change which takes place in flour I shall be most glad of their opinion on the matter, as I have not been able to find the subject referred to in any authorities I have consulted.

But in proof of the supposition being a correct one, I may mention that in musty flour where this state existed, I invariably found the glutin proportionably as the flour was bad

reduced in quantity, and that the portion remaining always deteriorated in quality.

In conclusion, Sir, I would wish just to refer to some of the disadvantages which accrue to the public from flour in the states referred to being employed, as it often is, in making bread; and to be more laconic I arrange them under different heads.

First. The bread is not so palatable, particularly if kept a day or two.

Second. It is less nutritious from the reduction in the amount of the glutin or staminal principle.

Third. It is injurious to health from being in a state approaching putrefaction, and also from alum being almost necessarily employed to convert it into saleable bread.

Fourth. It is a means of introducing dishonesty into legitimate trade; first, with the merchant miller, who has to mix bad with good flour to make it even saleable to the baker; and secondly, with the baker who is frequently obliged to use alum or some equivalent substance with this flour to convert it into bread of as good appearance and taste as will satisfy his customers.